# Comparison between Mass Ligation of Testicular Vessels versus Testicular Artery Sparing during Laparoscopic Bilateral Varicocelectomy

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## ABSTRACT

***Background:*** *Varicocele is an abnormal dilatation of the cremasteric venous plexus that may present with scrotal pain or subfertility. Laparoscopic approach for bilateral varicocelectomy is safe and cost effective. There is still a debate regarding the necessity of sparing the testicular artery during high varicocelectomy.* ***Aim:*** *the aim was to evaluate and compare artery sparing and mass ligation of testicular vessels during laparoscopic varicocelectomy.* ***Patients & Methods:*** *From April 2015 to January 2019, 37 patients underwent laparoscopic bilateral varicocelectomy at Ain shams university hospitals and were divided into 2 groups: Group A (19); mass ligation and Group B (18); artery sparing. Both groups were compared as regards the complications (hydrocele and recurrence) and testicular functions: average testis size, semen sperm count and male hormones (S. Testosterone and FSH). All the patients were followed up for one year.* ***Results:*** *The mean operative time in group A was 51.84 ± 8.08 min, in group B patients was 72 ± 13.5min (P:0.001). Early clinical hydrocele occurred in 5.3% in group A and in 22.2% in group B (P:0.18). Delayed radiological hydrocele occurred in 31.6% in group A and in 72.2% in group B (P:0.013). Subclinical recurrence occurred only in 11.1% in group B (P: 0.23). Average testicular size, semen sperm count and S. testosterone levels improved significantly in each group but when comparing both groups all results were insignificant.* ***Conclusion:*** *Based on the results of this study, given the increased potential for recurrence with the significant difference in operation time, no evidence was found to support the necessity of sparing the testicular artery when performing laparoscopic bilateral varicocelectomy; however, larger sized studies are required to confirm these results.*

***Key words:*** *Varicocelectomy, laparoscopic, mass ligation, artery sparing, hydrocele, recurrence, testicular functions.*

## INTRODUCTION

Varicocele was first recognized in the 16th century and Ambroise Pare (1500-1590) described this vascular abnormality due to melancholic blood [(1)]. A varicocele is an abnormal dilation and tortuosity of the veins within the pampiniform plexus of the spermatic cord, causing palpable or visible veins in the scrotum. While most varicoceles arise from abnormal retrograde flow within the internal spermatic veins draining the testis, another potential cause is the external cremasteric veins [(1,2)]. The reported prevalence of varicoceles varies but is generally estimated to be approximately 15% of all men, including 19% to 41% of men with primary infertility and 80% of men with secondary infertility, and it is recognized as the most common surgically correctable cause of male infertility [(3)]. Many times, adults are unaware to varicocele & usually, it is discovered accidentally during routine medical examination like school health check-up, prior to recruitment or while investigating a male for primary infertility [(1)].

Typically, varicocele is idiopathic, although acquired lesions with benign and malignant retroperitoneal disease do exist [(4)]. Varicoceles appear to be more common in tall males with lower BMI [(5,6)]. There is increased incidence of varicocele in 1st degree relatives suggesting a potential genetic basis [(7)]. Most varicoceles (80-90%) are left-sided & many anatomical factors have been postulated for this: Joining of left testicular vein to left renal vein at a right angle, Left testicular vein is longer than the right one and is liable to get compressed by loaded sigmoid colon and Left renal vein is often compressed between aorta and SMA [(1)]. A unilateral right-

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sided varicocele is rare, right side varicoceles are usually identified only when varicoceles is bilateral. However, an isolated right varicocele or one that is irreducible in the supine position necessitates searching for a possible retroperitoneal cause [2,4]. However, the most common cause of a right-sided varicocele is variant anatomy, with right spermatic vein entering the right renal vein similar to the left side usual anatomy [8,9].

A varicocele can result in testicular atrophy, which may impact testicular functions that include testosterone production and spermatogenesis [2,8]. It is well known that the ipsilateral testis in patients with varicoceles is smaller [10] and Haans et al [11] demonstrated that the loss of testicular volume in varicocele patients was associated with decreased sperm count. Varicocele is associated with impairment in spermatogenesis in the form of low sperm count, decreased motility & abnormal morphology. These abnormalities can occur in isolation or in combination (known as oligoasthenoteratospermia) [12]. The complex pathogenesis of varicocele-induced testicular dysfunction is incompletely understood, involving multiple factors such as altered blood flow, hyperthermia, oxidative stress & reflux of gonadotoxic metabolites resulting in low testosterone levels & impaired spermatogenesis [13]. Despite the association between varicoceles & testicular dysfunction, 85% of males with varicoceles are fertile [8].

Although most men remain asymptomatic, the most common clinical symptoms include male factor infertility & chronic scrotal pain. In men diagnosed with a varicocele, the incidence of pain is estimated to be up to 10% [2]. Other symptoms include heaviness in scrotum, difference in scrotal size, visible veins or rarely acute testicular pain [2,3,8]. Physical examination is the gold standard for diagnosing a varicocele [14]. Inspection and palpation of the scrotum should occur with the patient in the standing & supine positions, with & without a Valsalva. The varicocele is graded based on the ability of the examiner to visualize and/ or palpate the dilated spermatic cord veins. The currently accepted clinical grading is based on the Dubin & Amelar classification system [15,16] with WHO modification [17]: Grade I varicoceles are palpable only with Valsalva, grade II are palpable without Valsalva and grade III are easily visible through the scrotal skin without palpation or Valsalva. A subclinical varicocele is not visible or palpable, and is diagnosed incidentally with imaging. Typically, a Doppler ultrasound examination demonstrating veins 3 mm or larger in diameter with reversal of venous flow with Valsalva is consistent with diagnosis of varicocele [18,19].

Historically, guidelines have reserved varicocele surgery for infertile males with subnormal semen [20]. More recently, the American Society for Reproductive Medicine, together with the Society for Male Reproduction & Urology, published updated guidelines that stated that persistent varicocele related scrotal pain not responding to conservation is an indication for repair, regardless of fertility status [14,21]. The basis of varicocele treatment is blockade of the internal spermatic venous drainage of the testicle aiming to stop the backward flow of blood (cool off the testicles) [1,21]. Various techniques have been practiced for varicocele repair. These techniques can largely be classified into two categories: surgical & radiological. Surgical techniques can be classified on different criteria. There are conventional open, microsurgical and laparoscopic methods applied by means of surgical instruments. Meanwhile, there are retroperitoneal, inguinal, subinguinal and scrotal approaches according to the level of access [7,22]. Radiological treatment has been used as an alternative for surgery with the merits of less invasiveness and better chance to control smaller collaterals [22].

Laparoscopic approach was first introduced at 1991 by Aaberg et al. (23) then by Donovan & Winfield[24] as a minimally invasive surgical method for varicocele treatment. Currently accepted surgical techniques for varicocele repair include retroperitoneal (laparoscopic or open), inguinal and subinguinal (microsurgical or open) approaches [2,7]. The three most significant complications related specifically to varicocele repair include recurrent or persistent varicocele, hydrocele formation & testicular infarction (atrophy) due to testicular artery injury. The rates of these complications vary widely based on approach[2,4].

Despite of extensive information being present on varicoceles, the gold standard method of varicocele correction is still a matter of research[25]. In recent studies, laparoscopic

varicocelectomy has been preferred and has gained vast acceptance among surgeons [7,25]. Laparoscopic varicocelectomy allows for bilateral ligation of the spermatic vessels [26]. Both laparoscopic & inguinal microsurgical varicocelectomy have shown to be better outcome in many studies [25]. Microsurgical surgery seems to be associated with better outcomes (higher spontaneous pregnancy rates and lower postoperative recurrence), but the operating time for microsurgical repair is significantly longer than for laparoscopic repair. There is no difference between the microsurgical & laparoscopic techniques in long term complication rates. Further, microsurgical repair might require extensive training [27,28]. Recent studies have shown that laparoscopic varicocelectomy is safe, less invasive, cost effective & with a low recurrence rate when performed by experienced surgeons [7,8]. Till date, very few prospective randomized studies comparing both procedures had been published [25].

There is a debate regarding the significance of testicular artery sparing when performing a high varicocelectomy. While many believe ligating the testicular artery may impair future fertility, some studies have reported higher failure & recurrence rates with artery preservation [29,30,31,32]. The effect of artery preserving varicocele ligation is still controversial, as the testicles receive arterial supply mainly from the testicular artery, supplemented by the cremasteric & vasal arteries [33]. Mass ligation of the spermatic vessels above the internal inguinal ring allows for preserving the distal gonadal artery flow via collaterals from the proximal vasal artery [29]. The division of the spermatic vessels for difficult orchiopexy was suggested by Bevan in 1903. Later, Fowler & Stephens [34] described the anatomy that allowed division of the spermatic vessels to gain additional length and bring the testis to the scrotum while maintaining collateral blood supply [29]. The high retroperitoneal mass ligation of a varicocele has the advantage of a lower incidence of recurrence due to ligating the periarterial plexus of veins (venae comitantes), which may present as the source of recurrence [26].

To help resolve the debate regarding the significance of artery sparing, we sought to compare the complications rate amongst those who have undergone artery sparing and those who have had the artery sacrificed laparoscopically, as well as compare the testicular functions.

## PATIENTS AND METHODS

This study was conducted during the period from April 2015 to January 2019 on 37 patients who underwent laparoscopic bilateral varicocelectomy in Ain Shams university hospitals. Both indications for surgery (pain and sub-fertility) were included; 25 of them were complaining of scrotal pain/discomfort that didn't respond to conservative measures and 12 were complaining of sub-fertility (either primary or secondary). All unilateral cases, extremes of age (below 18 and above 60) and patients with concomitant hernia, UTI, epididymo-orchitis, previous groin surgery and pre-existing hydrocele were excluded.

The patients were scheduled to have laparoscopic bilateral varicocelectomy by attacking the testicular vessels above the internal ring. A written informed consent was obtained from the patients after explaining the procedure, possible complications and their enrollment in a clinical study. This study was approved by the Ethical Committee of the Faculty of Medicine, Ain Shams University.

All patients were subjected to full history taking and full clinical examination that showed bilateral varicocele (grade 2 or 3 at least on one side). Varicocele was diagnosed primarily by a physical examination with the patients in an erect position. All patients underwent scrotal duplex ultrasound that confirmed the diagnosis of bilateral varicocele (2 or more dilated veins with at least one vein having diameter of 3 mm or more) and defined the severity of venous reflux (spontaneous or with Valsalva). Testicular volume of each side was measured by U/S using the formula: 0.71 × length × width × height (35). All the patients underwent routine preoperative laboratory investigations including CBC, bleeding profile, KFTs and LFTs together with serum Testosterone level, FSH and semen analysis. We used the criteria of normal semen proposed by WHO in 2010 [36].

The study started by 39 patients who were randomly divided into 2 groups: Group A; 20 patients underwent laparoscopic bilateral mass ligation of testicular vessels (artery, veins and lymphatics) and Group B; 19 patients underwent

laparoscopic bilateral selective ligation of testicular (veins and lymphatics) sparing the artery. Two patients were lost during follow up, one from each group, so their data were excluded from the results. There was no statistically significant difference regarding age, indication of surgery, testicular size or hormonal and semen parameters among both groups, see table 1.

All the patients were advised to evacuate their bladder before surgery. All patients received general anesthesia with antibiotics on induction and were placed in a supine position with slight Trendelenburg's. All the operations were performed using a standard laparoscopic technique with 3 ports inserted. Supra umbilical 10 mm port for $30^{o}$ camera and 2 working 5 mm ports at both lumbar regions just lateral to rectus muscle (mid clavicular lines) were used in group B patients, while in group A, a 10 mm working port was used instead of one 5 mm port. Changing one of the two 5 mm ports to another 10 mm one was done in case clips were needed in group B. Ultrasonic & electro-cautery energy sources were used as needed.

In all patients, pneumoperitoneum was established at 13-14 mm Hg using verrus needle, and ports were inserted as described above. The internal ring was identified by the appearance of the vas deferens as it separated from the spermatic cord and entered into the pelvis. The peritoneum was incised and dissected along the testicular vessels for approximately 1cm using scissors. In group **A** patients, bloc dissection of testicular vessels (artery, veins and lymphatics) was done and mass ligation was done by clipping followed by ultrasonic or electrocautery division (see Fig, 1). In group **B** patients, testicular vessels were dissected and the artery was identified, dissected and excluded followed by ultrasonic division of testicular veins (and lymphatics) (see Fig. 2). After finishing one side, the other side was done at same setting by the same technique. In cases where accidental injury of the artery occurred during its dissection from veins in the first side, the artery was clipped and these patients were included in group A. **NB**: In one case the artery was injured during dissection and clipped in the second side (the artery was spared at the first side) and this patient was excluded from our study.

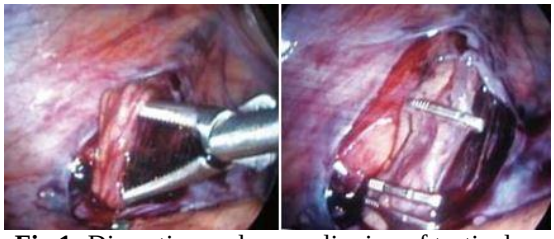

**Fig 1:** Dissection and mass clipping of testicular vessels in a group A patient.


**Fig 2:** Harmonic division of testicular vessels sparing the artery in a group B patient.

Operation time (from skin to skin) in minutes was noted and recorded together with intraoperative complications. All the patients were discharged home on the same day after adequate analgesia except for two patients from group B with delayed recovery who were kept at hospital till next day morning. Follow up visits were scheduled at 10 days, 3 months, 6 months and one year.

The patients were seen after 10 days for stitches removal and examination for assessment of post operative complications as hydrocele in one or both sides. At 3 months visit, the patients were seen for assessment of postoperative hydrocele, disappearance/ persistence of clinical varicocele & improvement of preoperative complaint. At 6 months visit, the patients were clinically examined, semen analysis was done & scrotal duplex ultrasound was done to assess residual hydrocele and disappearance/ persistence of varicocele. At one year visit, the patients were examined and scrotal duplex ultrasound was repeated & average testicular size assessed and hormonal assay (s. Testosterone & FSH) was done.

**Statistical package and Statistical analysis:** The collected data was revised, coded, tabulated and introduced to a PC using Statistical package for Social Science **(IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp).** Quantitative variables are expressed as mean and SD or as median and interquartile range (IQR) in cases of non parametric variables .Qualitative variables are expressed as frequencies and percents. **Student t test** or **Mann Whitney** Test was used to compare a continuous variable between two study groups. **Chi square** and **Fisher's exact tests were** used to examine the relationship between Categorical variables. Paired data were compared using **paired t test**. P-value< 0.05 was considered statistically significant.

## RESULTS

The study was completed on 37 patients whose age ranged from 19 to 57 years (mean 29.38±8.76). All were medically free except for; 3 patients had essential hypertension and 2 patients had type 2 DM. Their mean preoperative testicular size was 14.17 ± 1.06 mL, while their mean preoperative total sperm concentration was 16.36 ± 9.7 million/mL. Their mean preoperative s. Testosterone level was 559.22 ± 199.77 ng/dL, while their mean preoperative FSH level was 7.68±1.34IU/L.

**Table 1:** Preoperative data and its significance (all insignificant):

| | | **Total** | **Group A (no:19)** | **Group B (no:18)** | **P- value** |
|---|---|---|---|---|---|
| | | Mean ±SD / N (%) | Mean ±SD / N (%) | Mean ±SD / N (%) | |
| Age mean | | 29.38±8.76 | 28.95±8.26 | 29.83±9.48 | 0.763* |
| Indication (no) | Pain | 25 (67.6%) | 13 (68.4%) | 12 (66.7%) | 0.909** |
| | Subfertility | 12 (32.4%) | 6 (31.6%) | 6 (33.3%) | |
| Mean Testicular size (mL) | | 14.17 ± 1.06 | 14.08 ± 1.15 | 14.27 ± 0.98 | 0.609* |
| Total Sperm conc.(million/mL) | | 16.36 ± 9.7 | 16.69 ± 9.74 | 16 ± 9.91 | 0.831* |
| Mean s. Testost. level(ng/dL) | | 559.22 ± 199.77 | 560.37 ± 201.44 | 558 ± 203.82 | 0.972* |
| Mean s. FSH level (IU/L) | | 7.68±1.34 | 7.69±1.21 | 7.66 ±1.6 | 0.940* |

*student t test **chi square test

The mean operative time in group A patients was 51.84 ± 8.08 min., while the mean operative time in group B patients was 72 ± 13.5min. There were no intraoperative complications noticed in all patients except for 2 cases of intestinal superficial hematomas. All the patients were discharged home on the same day after adequate analgesia (single opiate dose) except for two patients from group B with delayed recovery who were kept at hospital till next day morning (2/18: 11.1%, statistically insignificant; P value: 0.23 ) and all returned to normal activity within few days.

Only one diabetic patient in group A suffered from wound infection at the supra umbilical wound that required early removal of stitches and drainage of infected seroma followed by oral antibiotics and daily dressing. Three patients had mild surgical emphysema that needed few days to resolve completely. All the 25 patients who complained of scrotal pain noticed mild to marked improvement of their complaint.

Five patients developed postoperative hydrocele that was diagnosed at the 10th day visit; 1 patient in group A (1/19: 5.3%) and 4 patients in group B (4/18: 22.2%). All hydrocele cases were managed conservatively and they showed mild improvement after 3 months & marked improvement after 6 months. When group A was compared to group B, the difference was statistically insignificant; P value: 0.18.

Scrotal duplex ultrasound done at 6 months showed disappearance of preoperative dilated veins and absence of reflux in all patients, also showed minimal to mild subclinical hydrocele in 6 patients in group A (6/19: 31.6%) and 13 patients in group B (13/18: 72.2%). When comparing group A to group B, results were statistically significant; P value: 0.013.

**Table 2:** Operative time, operative and post operative complications.

| | Group A (no. 19) | Group B (no. 18) | P- value |
|---|---|---|---|
| Mean Operative time (min.) | 51.84 ± 8.08 | 72 ± 13.5 | 0.001 |
| Bowel surface hematomas | -- | 2 (11.1%) | 0.230** |
| Delayed recovery (>12 hr hospital stay) | -- | 2 (11.1%) | 0.230** |
| Wound infection | 1 (5.3%) | -- | 1.0** |
| Early clinical hydrocele | 1 (5.3%) | 4 (22.2%) | 0.18** |
| Delayed radiological hydrocele (6 months) | 6 (31.6%) | 13 (72.2%) | 0.013* |

‡student t test *chi square test **Fisher exact test

Semen analysis done at 6 months showed marked improvement in both groups. In group A: total sperm concentration was 20.16 ± 6.91 million/mL, while in group B: total sperm concentration was 19.7 ± 6.38 million/mL. When comparing both groups to their preoperative data, changes in each group were statistically significant; P value: 0.001 at both groups. But when comparing group A to group B, changes were statistically insignificant; P value: 0.84.

Scrotal duplex ultrasound done at one year showed complete disappearance of any hydrocele in all patients and showed grade 1 non refluxing varicocele in 2 patients in group B (2/18: 11.1%) and the 2 patients were symptomless with no clinically detected dilated veins. Recurrence of subclinical varicocele in group B was statistically insignificant; P value: 0.23.

Mean average testicular size in group A patients was 14.87 ± 0.88 mL, while mean average testicular size in group B was 15.07 ± 1.11 mL. When comparing both groups to preoperative data, changes were statistically significant; P value: both were 0.0001. When comparing group A to group B, changes were statistically insignificant; P value: 0.55.

As regard hormonal assay done after one year, mean s. Testosterone level rised to 622.53 ± 145.47 ng/dL in group A (statistically significant; P value: 0.002), while mean s. Testosterone level rised to 627.4 ± 140.6 ng/dL in group B (statistically significant; P value: 0.001 ). When comparing group A to group B, results were statistically insignificant; P value: 0.91. Mean s. FSH level decreased to 7.45 ± 1.04 IU/L in group A (statistically significant; P value: 0.016) and decreased to 7.35 ± 1.26 IU/L in group B (statistically significant; P value: 0.027). When comparing group A to group B, results were statistically insignificant; P value: 0.79.

**Table 3:** Testicular functions parameters, their changes after one year and their significance.

| | Group A | | | Group B | | | post A to post B P** |
|---|---|---|---|---|---|---|---|
| | Preop | Postop | P* | Preop | Postop | P* | |
| Mean average Testis size (mL) | 14.0 ± 1.1 | 14.87 ± 0.88 | 0.0001 | 14.27 ± 0.98 | 15.07 ± 1.11 | 0.0001 | 0.55 |
| Total Sperm conc.(million/mL) | 16.6± 9.7 | 20.16 ± 6.91 | 0.001 | 16 ± 9.9 | 19.7 ± 6.38 | 0.001 | 0.84 |
| Mean s. Testost. level(ng/dL) | 560.3 ± 201.4 | 622.53 ± 145.47 | 0.002 | 558 ± 203.8 | 627.4 ± 140.6 | 0.001 | 0.91 |
| Mean s. FSH level (IU/L) | 7.7 ± 1.2 | 7.45 ± 1.04 | 0.016 | 7.66 ± 1.5 | 7.35 ± 1.26 | 0.027 | 0.79 |

*Student t test **Paired t test

**Table 4:** Percent of change in testicular functions parameters between the two study groups.

| | Group A | | Group B | | p** |
|---|---|---|---|---|---|
| | **Mean± SD** | **Median(IQR)*** | **Mean±SD** | **Median(IQR)*** | |
| Testicular size % of change | 5.87 ± 4.74 | 6.08 (1.86 - 10.45) | 5.71 ± 5.08 | 5.98 (2.24 - 8.03) | 0.832 |
| Total Sperm conc % of change | 73.26±117.38 | 31.25 (4.55 - 77.78) | 130.81±262.12 | 19.35 (3.57 - 142.86) | 0.976 |
| Mean Testost. % of change | 18.66±27.59 | 8.28 (0.58 - 38.18) | 20.79 ± 27.08 | 6.31 (2.4 - 41.69) | 0.832 |
| Mean s. FSH % of change | -2.82±4.94 | -2.7 (-4.71 - 1.41) | -3.47 ± 6.28 | -1.98 (-7.62 - 0) | 0.891 |

*interquartile range **Mann Whitney test

## DISCUSSION

Varicocele is a palpable dilation in the pampiniform plexus of veins in the scrotal sac secondary to retrograde flow of blood to the testicle [(37)]. Varicocele is associated with a time dependent arrest of testicular growth and decline in semen quality in adolescents and adult males and decline in male hormone production also [(37,38)]. Testicular biopsy in varicocele patients shows decreased tubular diameter, Leydig cell atrophy with vacuolization & decreased Leydig cells in testicular tissue when staining for testosterone. It has been noted that varicocele is more common in men with secondary infertility compared to primary infertility suggesting a progressive decline in fertility associated with an untreated varicocele[(39)]. The most common indications for varicocelectomy are Subfertility and chronic scrotal pain. The basis of varicocele treatment is blockade of the internal spermatic venous drainage of the testicle [(21)].

There are several surgical approaches to the varicocele, all of which produce consistent results and the approach is largely dependent on surgeon preference. All surgical techniques involve the ligation of the spermatic veins with the main differences involving the level of the ligation (proximal or distal) and whether the testicular artery & lymphatic vessels are spared or ligated along with the veins. The techniques include abdominal retroperitoneal (Palomo), inguinal (Ivanissevich) & subinguinal approaches [(40)]. Despite of extensive information being present on varicoceles the gold standard method of varicocele correction is still a matter of research. In recent studies laparoscopic varicocelectomy has been preferred & has gained vast acceptance among surgeons due to its rapid, safe, effective & minimally invasive features [(25)]. There was much debate regarding the significance of artery sparing when performing varicocelectomy. Several studies found that no differences in semen parameters & pregnancy rates were detected between testicular artery sparing & ligation; and higher recurrence rates & persistence of varicocele in artery preserving patients were reported. Conversely, other reports indicated that artery sparing procedure was significantly superior in improvement of sperm concentration, motility & morphology than ligation [(41)].

Some surgeons may choose artery sparing varicocelectomy in patients who have had previous inguinal surgery out of fear that some degree of arterial compromise occurred at the time of initial inguinal surgery[(29)]. That is why we excluded patients with previous inguinal surgery from this study and this needs to be addressed separately.

This study was designed to compare testicular vessels mass ligation versus artery sparing during laparoscopic bilateral varicocelectomy as regards the complications and testicular functions affection. We have chosen average testicular size, semen sperm count and hormones (S. testosterone and FSH) as indicators for the testicular function. There are very little studies in literature comparing both techniques laparoscopically & rarely hormones have been compared.

In this study, the operative time in the mass ligation group (51.84±8.08min.) was significantly lower than that in the artery sparing group (72±13.5min.) (P: 0.001). All early operative complications rates did not differ significantly among the two groups. Scrotal duplex ultrasound (done at 6 months) showed disappearance of

preoperative dilated veins and absence of reflux in all patients. All the 25 patients with scrotal pain noticed mild to marked improvement of their complaint. The 12 patients with Subfertility had marked improvement in semen quality, but pregnancy rates were not studied.

Some studies, as Feber & Kass [30], have suggested that an artery sparing is inferior to the Palomo; recurrence with open mass in 312 adolescent patients was 3.9% and hydrocele occurred in 29%. Hassan et al.[42] in their laparoscopic study encountered recurrence in 1.3% in 89 patients with mass ligation & encountered hydrocele in 22.8%. The study by Glassberg et al. [43] identified a recurrence rate in the artery sparing group that was more than twice the rate found when the artery was taken. This finding, however, was not found to be statistically significant (p = 0.09). In a study by Tarun et al.[44], hydrocele occurred in 4 patients (11.42%) when only ligation of veins was done and in 2 patients (4.88%) when mass ligation was done & the only recurrence (2.85%) was with artery preservation. Agnifilli et al.[45] suggested that laparoscopic high mass ligation of both testicular artery and vein had very low recurrence rates. In a laparoscopic study by Micali et al.[26], all patients showed no recurrence of varicocele or secondary hydrocele with mass ligation. In our study, recurrence of radiological subclinical varicocele at the end of the first year was noticed in 11% of patients with the artery preserved and was not noticed when the artery was mass ligated, but this was statistically insignificant; P value: 0.23. Early clinical hydrocele surprisingly occurred more with artery sparing (22.2%) than with mass ligation (5.3%) but this was statistically insignificant (P: 0.18), however delayed subclinical hydrocele (at 6 months) was also more with artery sparing (72.2%) than with mass ligation (31.6%) but statistically significant (P: 0.013). No case required any surgical intervention.

In this study, semen analysis done at 6 months showed significant improvement in sperm count in both groups (P: 0.001 in each group) but no significant difference between artery sparing or sacrificing (P: 0.84). Average testicular size after one year showed significant increase in both groups (P: 0.0001 in each group) and this may be explained by the loss of the detrimental effect of varicocele on the testis or by mild tissue oedema, but no significant difference was found between artery sparing or sacrificing (P: 0.55). Yamamoto et al. [46] compared the two open surgical methods and found no significant difference between testicular artery preservation and ligation varicocelectomy regarding semen quality, pregnancy rates, or testicular volume. Huk et al. [47] found that ligation of vein and artery produced better improvement of semen characteristics and percentage of pregnancies in comparison with artery-sparing. In a laparoscopic study by Fast et al. [29] comparing 41 patients with artery sparing and 312 patients with artery ligation, no patients experienced testicular atrophy. Diamond et al. [48] concluded that laparoscopic and Palomo approaches were more successful than microsurgery and artery sparing. In contrast, Zampieri et al. [49] and Guo et al.[41] found that those with artery preservation had better postoperative semen parameters than those who had undergone mass ligation that included the artery.

Much of the current literature regarding testosterone and varicoceles has been in the context of studying male infertility and to a less extent hypogonadism (low S. testosterone level) and most of them were using the microsurgical artery sparing techniques [39]. Reşorlu et al. [50] reviewed 96 men with various complaints with varicocele. It was not reported what percentage were infertile. They did not demonstrate any statistically significant increase in Testosterone with microsurgical subinguinal varicocelectomy. Rodriguez et al. [51] studied 202 men who were referred for left testicular pain or accidentally discovered. No patients had a fertility complaint. All men underwent inguinal varicocelectomy. Testosterone levels did increase from 648±156 to 709±232 ng/dL, however this was not significant. Hsiao et al. [52] retrospectively reviewed 78 men (82% for infertility) undergoing microsurgical subinguinal varicocele repair. All had Testosterone <400 ng/dL. There was a statistically significant increase in Testosterone within the entire population (P<0.0001). In our study which combined both indications: pain and sub-fertility in each group, mean s. Testosterone level rised significantly and mean s. FSH level decreased significantly in each group, but when mass ligation and artery sparing were compared to each other there was no statistical difference (P values 0.91 and 0.79 respectively). Sacrificing the

testicular artery laparoscopically didn't alter hormones levels.

This study has some limitations: its size is not large enough to show statistically significant difference in some aspects, the follow up time is only one year which may be not sufficient to evaluate varicocele recurrence properly. Laparoscopic intra operative identification of the testicular artery was by naked eye appearance and pulsations only with no helping tools as Doppler. Both indications for surgery (pain & Subfertility) were included together in each study group and these 2 groups of indications vary widely as regard some parameters of comparison as semen sperm count and serum hormones levels which may have had impact on results if both indications were separated into 2 groups. Pregnancy rates were not measured as this requires higher number of patients and much longer time.

## CONCLUSION

Artery sparing during laparoscopic bilateral varicocelectomy doesn't seem to have any added benefit to the patients who hadn't had any previous inguinal surgery; all testicular functions were not affected. Early clinical hydrocele and subclinical varicocele recurrence at one year occurred more with artery sparing, yet not statistically significant. And the operative time of the laparoscopic procedure was significantly longer in the artery sparing patients.

Based on the results of this study, given the increased potential for recurrence with the significant difference in operation time, no evidence was found to support the necessity of dissection, identification and exclusion of the testicular artery when performing laparoscopic bilateral varicocelectomy; however, larger sized studies are required to confirm these results.

## REFERENCES


1. Verma D, Lal C, Sharma A & Sirwi M (2017): Laparoscopic versus open surgical management of idiopathic varicocele: a study on 100 patients. Int Surg J. 2017 Sep;4(9):3071-3076.
2. Owen RC, McCormick BJ, Figler BD and Coward RM (2017): A review of varicocele repair for pain. Transl Androl Urol 2017;6(1):S20-S29
3. Chung JM and Lee SD (2018): Current Issues in Adolescent Varicocele: Pediatric Urological Perspectives. World J Mens Health 2018 May 36(2): 123-131
4. Sekhar IC and Rao AVM (2017). Clinical study of management of varicocele. J. Evolution Med. Dent. Sci. 2017;6(32):2609-2614
5. Delaney DP, Carr MC, Kolon TF, Snyder HM 3rd & Zderic SA (2004): The physical characteristics of young males with varicocele. BJU Int.2004;94:624- 626.
6. May M, Taymoorian K, Beutner S, Helke C, Braun KP, Lein M, Roigas J & Hoschke B (2006): Body size and weight as predisposing factors in varicocele. Scand J Urol Nephrol.2006; 40:45-48.
7. Maheshwari R, Mandia R, Malik P, Haldeniya K & Harish NL (2014): Comparison of Laparoscopic and Open High Ligation Procedure for Varicocele. Global Journal of Medical Research Volume 14 Issue 5 Version 1.0 Year 2014: 23-26
8. Talaie R, Young SJ, Shrestha P, Flanagan SM, Rosenberg MS and Golzarian J (2016): Image-Guided Treatment of Varicoceles: A Brief Literature Review and Technical Note. Semin Intervent Radiol 2016;33:240–243
9. Pastuszak AW and Wang R (2015): Varicocele and testicular function. Asian J Androl 2015;17(4):659–667
10. Lyon RP, Marshall S & Scott MP (1982): Varicocele in childhood and adolescence: implication in adulthood infertility? Urology 1982;19(6):641–4.
11. Haans LC, Laven JS, Mali WP, et al. (1991): Testis volumes, semen quality, and hormonal patterns in adolescents with and without a varicocele. Fertil Steril 1991;56(4):731–6.
12. MacLeod J (1965): Seminal cytology in the presence of varicocele. Fertil Steril 1965;16(6):735–57.
13. Will MA, Swain J, Fode M, Sonksen J, Christman GM & Ohl D (2011): The great debate: varicocele treatment and impact on fertility. Fertil Steril 2011;95(3):841–852
14. Practice Committee of the American Society for Reproductive Society for Male R, Urology. Report on varicocele and infertility: a committee opinion. Fertil Steril 2014;102:1556-60.

15. Amelar RD, Dubin L (1987): Therapeutic implications of left, right, and bilateral varicocelectomy. Urology 1987;30:53-9.
16. Dubin L, Amelar RD (1970): Varicocele size and results of varicocelectomy in selected subfertile men with varicocele. Fertil Steril 1970;21:606-9.
17. Rowe PJ, Comhaire FH, Hargreave TB, Mahmoud AM, World Health Organization . WHO Manual for the Standardized Investigation, Diagnosis, and Management of the Infertile Male. Cambridge – New York: 2000.
18. Stahl P and Schlegel PN (2011): Standardization and documentation of varicocele evaluation. Curr Opin Urol. 2011;21:500–5.
19. Pauroso S, Di Leo N, Fulle I, Di Segni M, Alessi S and Maggini E (2011): Varicocele: Ultrasonographic assessment in daily clinical practice. Journal of Ultrasound (2011) 14: 199-204
20. Male Infertility Best Practice Policy Committee of the American Urological Association; Practice Committee of the American Society for Reproductive Medicine. Report on varicocele and infertility. Fertil Steril 2004;82 Suppl 1:S142-5.
21. Masson P and Brannigan RE (2014): The varicocele. Urol Clin North Am 2014;41:129-44.
22. Cho KS and Seo JT (2014): Effect of Varicocelectomy on Male Infertility. Korean J Urol 2014;55:703-709.
23. Aaberg RA, Vancaillie TG & Schuessler WW (1991): Laparoscopic varicocele ligation: a new technique. Fertil Steril. 1991;56:776–777
24. Donovan JF & Winfield HN (1992): Laparoscopic varix ligation. J Urol 1992,147:77–81.
25. Choudhary V, Mathur RK and Sharma BK (2017): Comparative Study of Laparoscopic Varicocele Ligation Versus Inguinal Varicocelectomy. Int.j.med.sci.educ. Oct-Dec 2017; 4(4):323-327
26. Micali S, Ghaith A, Martorana E, Zordani A, Territo A and Bianchi G (2014): Bilateral spermatic cord en bloc ligation by laparoendoscopic single-site surgery: preliminary experience compared to conventional laparoscopy. BMC Urology 2014; 14:83
27. Baazeem A, Belzile E, Ciampi A, Dohle G, Jarvi K, Salonia A, Weidner W and Zini A (2011): Varicocele and male factor infertility treatment: a new meta-analysis and review of the role of varicocele repair. Eur Urol; 60(4):796–808.
28. Wu T, Duan X, Yang X, Deng X and Cui S (2016): Laparoendoscopic single‐site varicocelectomy compared with conventional laparoscopic surgery: a systematic review and meta‐analysis. SpringerPlus (2016); 5:1483
29. Fast AM, Deibert CM, Van Batavia JP, Nees SN and Glassberg KI (2014): Adolescent varicocelectomy: does artery sparing influence recurrence rate and/or catch-up growth? Andrology, 2014; 2: 159–164
30. Feber KM and Kass EJ (2008): Varicocelectomy in adolescent boys: long-term experience with the Palomo procedure. J Urol; 180: 1657– 1659.
31. Borruto FA, Impellizzeri P, Antonuccio P, Finocchiaro A, Scalfari G, et al. (2010): Laparoscopic vs. open varicocelectomy in children and adolescents: review of the recent literature and meta‐analysis. J Pediatr Surg 2010; 45: 2464–9.
32. Kim KS, Lee C, Song SH, Cho SJ, Park S, et al. (2014): Impact of internal spermatic artery preservation during laparoscopic varicocelectomy on recurrence and the catch‐up growth rate in adolescents. J Pediatr Urol 2014; 10: 435–40.
33. Mostafa T, Labib I, El-Khayat Y, El-Rahman El-Shahat A & Gadallah A (2008): Human testicular arterial supply: gross anatomy, corrosion cast, and radiologic study. Fertil Steril 2008, 90:2226.
34. Fowler R & Stephens FD (1959): The role of testicular vascular anatomy in the salvage of high undescended testis. Aust New Zeal J Surg 1959, 29:92.
35. Sakamoto H, Saito K, Oohta M, Inoue K, Ogawa Y and Yoshida H (2007): Testicular volume measurement: comparison of ultrasonography, orchidometry, and water displacement. Urology. 2007 Jan;69(1):152-7.
36. Cooper TG, Noonan E, von Eckardstein S, Auger J, Baker HW, Behre HM, et al. (2010):

World Health Organization reference values for human semen characteristics. Hum Reprod Update; 16:231–45.
37. Fischa H and Hyun G (2012): Varicocele repair for low testosterone. Curr Opin Urol 2012; 22:495–498.
38. Chen C (2016): Laparoscopic Varicocelectomy: My Personal Experience of 4000 Cases. Int Surg 2016;101:2–6.
39. Whelan P and Levine L (2016): Effects of varicocelectomy on serum testosterone. Transl Androl Urol 2016;5(6):866-876.
40. Diamond DA, Gargollo PC and Caldamone AA (2011): Current management principles for adolescent Varicocele. Fertil Steril 2011;96:1294–8.
41. Guo LQ, Zhang XL, Liu YQ, Sun WD, Zhao ST and Yuan MZ (2017): The application of laparoscopic Doppler ultrasound during laparoscopic varicocelectomy in infertile men. Asian Journal of Andrology (2017); 19: 214–218.
42. Hassan JM, Adams MC, Pope JC, Demarco RT & Brock JW (2006): Hydrocele formation following laparoscopic varicocelectomy. J Urol 2006;175:1076–9.
43. Glassberg KI, Badalato GM, Poon SA, Mercado MA, Raimondi PM & Gasalberti A (2011): Evaluation and management of the persistent/ recurrent varicocele. Urology 77: 1194–1198.
44. Tarun A, Veenu J, Dhanesh K and Sanjay P (2009): Laparoscopic Management of Varicocele – A Hospital based study. The Internet Journal of Surgery. 2009 Volume 23 Number 2: 1-5
45. Agnifili A, Schietroma M, Carlei F, De Berardis B, Pescosolido A, Giuliani A, Venturoni A, Amicucci G (2008): Recurrences, testicular growth and semen parameters after laparoscopic Palomo varicocelectomy. Chir Ital; 2008; 60(4): 549-54.
46. Yamamoto M, Tsuji Y, Ohmura M, Hibi H & Miyake K (1995): Comparison of artery-ligating and artery-preserving varicocelectomy: effect on post-operative spermatogenesis. Andrologia; 1995; 27(1): 37-40.
47. Huk J, Fryczkowski M, Bihun M & Połać R (2001): Laparoscopic varicocele ligation. The comparative assessment of artery-ligating and artery-preserving varicocelectomy. Wiad Lek; 2001; 54(11-12): 621-31.
48. Diamond DA, Xuewu J, Cilento BG Jr, Bauer SB, Peters CA, Borer JG, Mandell J, Cendron M, Rosoklija I, Zurakowski D & Retik AB (2009): Varicocele surgery: a decade's experience at a children's hospital. BJU Int; 2009; 104(2): 246-9.
49. Zampieri N, Zuin V, Corroppolo M, Chironi C, Cervellione RM & Camoglio FS (2007): Varicocele and adolescents: semen quality after 2 different laparoscopic procedures. J Androl 2007, 28:727-733.
50. Reşorlu B, Cengiz K, Erhan S, et al. (2010): The Significance of Age on Success of Surgery for Patients with Varicocele. Int Urol Nephrol 2010;42:351-56.
51. Rodriguez Peña M, Alescio L, Russell A, et al. (2009): Predictors of Improved Seminal Parameters and Fertility after Varicocele Repair in Young Adults. Andrologia 2009;41:277-81.
52. Hsiao W, Rosoff JS, Pale JR, et al. (2011): Older age is associated with similar improvements in semen parameters and testosterone after subinguinal microsurgical varicocelectomy. J Urol 2011;185:620-5.